

ON THE
LOCALIZATION OF THE CORTICAL
MOTOR CENTRE

OF THE
HUMAN LARYNX

BY ✓

D. BRYSON DELAVAN, M.D.

NEW YORK

SECRETARY OF THE AMERICAN LARYNGOLOGICAL ASSOCIATION; SURGEON TO
THE THROAT DEPARTMENT OF THE DEMILT DISPENSARY

(READ BEFORE THE LARYNGOLOGICAL SECTION OF THE EIGHTH
INTERNATIONAL MEDICAL CONGRESS, COPENHAGEN, August
14, 1884.)

Reprinted from THE MEDICAL RECORD, Feb. 14, 1885.



NEW YORK :
TROW'S PRINTING AND BOOKBINDING CO.,
201-213 EAST TWELFTH STREET.
1885.

ON THE
LOCALIZATION OF THE CORTICAL
MOTOR CENTRE

OF THE
HUMAN LARYNX

BY ✓

D. BRYSON DELAVAN, M.D.

NEW YORK

SECRETARY OF THE AMERICAN LARYNGOLOGICAL ASSOCIATION; SURGEON TO
THE THROAT DEPARTMENT OF THE DEMILT DISPENSARY

(READ BEFORE THE LARYNGOLOGICAL SECTION OF THE EIGHTH
INTERNATIONAL MEDICAL CONGRESS, COPENHAGEN, August
14, 1884.)

Reprinted from THE MEDICAL RECORD, *Feb. 14, 1885.*



NEW YORK :
TROW'S PRINTING AND BOOKBINDING CO.,

201-213 EAST TWELFTH STREET.

1885.

ON THE

Localization of the Cortical Motor Centre of the Larynx.

IN the light of important discoveries made in recent years by such investigators as Ferrier, Charcot, Hitzig, and others, the theory that there reside in the cortex of the brain definite centres of muscular action, has slowly but steadily gained a strong position in physiological science, and has attracted the support of a large and constantly increasing number of competent observers.¹

Although, as the outgrowth of these studies, much has been done to determine the motor centres of other organs, general and special, the centre for the human larynx has, up to the present time, remained an unexplored field.

It will be the object of this paper, therefore, to call attention to certain anatomical, physiological, and pathological considerations, which, if they do not actually prove, at least strongly suggest, the probability that such a centre does exist, and, secondly, to indicate, as nearly as may be, the precise location of this area.

I. In regard to the anatomical considerations, it has long ago been shown that the cortical centre for the lower limbs is in the region of the superior part of the fourth frontal and the ascending parietal convolutions; that for the arms in the middle part of the ascending frontal; that for the face in the inferior part of the ascending frontal; while that for speech occupies the

¹ Of the practical value of a complete knowledge of the functions of the brain-cortex in the diagnosis of pathological conditions of that organ, both medical and surgical, it is not necessary here to speak. For a most graphic and interesting exposition of the subject in general in its relation to surgical diagnosis, the reader is referred to the excellent work of Dr. J. Lucas-Championnière, Paris, 1878, entitled *La Trépanation Guidée par les Localisations Cérébrales*.

lower part of the third left frontal, toward where it joins the ascending frontal.

By analogy, it would be natural to expect to find the centre for the larynx in the vicinity of the centre for the movements of the face and for speech.

As to its nutrition, this whole motor region, adjacent to the fissure of Rolando, is supplied by one of the branches of the middle cerebral artery. According to Quain,¹ the main trunk of the middle cerebral artery passes upward and outward to the fissure of Silvius, until it reaches the Island of Reil, on the surface of which it divides into four branches. The first branch is limited in its distribution to the outer part of the orbital surface, and the adjacent inferior frontal convolution. The second branch supplies the posterior part of the middle frontal, and the chief part of the ascending frontal convolutions. The third branch passes in the fissure of Rolando to the rest of the ascending frontal and to the ascending parietal convolutions, and to the anterior part of the superior parietal lobule; and the fourth, lying in the posterior branch of the fissure of Silvius, supplies the inferior parietal lobule and the superior temporo-sphenoidal convolutions. Again, the cerebral arteries anastomose but sparingly at their extremities, so that each branch supplies, as it were, a territory of its own.² "All of the nutritive arteries are end arteries,"³ while some of the smaller branches distributed to the cortex are also of this nature.

II. *Physiologically*.—At a meeting of the Physiological Society held in Berlin, November 23, 1883,⁴ Dr. Herman Krause stated that he had, in the laboratory of Professor Munk, investigated experimentally the supposition that the voluntary muscles of the larynx would be found to have a cortical centre, and had confirmed it. On exposing a dog's larynx, and irritating a certain section of the cortex by moderate electrical currents, he invariably noticed the rise of the larynx, the movement of the vocal bands to a position midway between expiration and phonation, the rising of the palate, the contraction of the constrictor pharyngis, and movements at the base of the tongue.

That the part of the cortex in question was the centre of the laryngeal movement was further confirmed by ex-

¹ Quain's Anatomy, vol. i., p. 379.

² Ibid.

³ Coats' Manual of Pathology, p. 414.

⁴ Archiv für Anatomie und Physiologie, Physiologische Abtheilung.

periments of extirpation, which were performed successfully on both sides in ten dogs.

The cortex was experimented on, first on one side and then on the other, and after all the inflammatory symptoms had subsided, and the cerebral wounds were cicatrized, or in process of cicatrization, it was found that eight dogs had entirely lost the power of barking, and, on attempting to bark, uttered either no sound or only a hoarse whine. In the case of the two dogs which, after the operation, continued able to bark, it was shown that the excision had not been properly performed.

From these experiments it would appear that there is, in the brain of the dog, a cortical centre for the muscles of the larynx.

III. With the foregoing data at our command, the significance of the pathological evidence offered by the following very rare cases is particularly striking.

CASE I.—Male, aged sixty; retired merchant; family history excellent, except for rheumatic diathesis. Has always been very strong and healthy, of regular habits, and strictly temperate in the use of alcoholics, but an immoderate tobacco smoker. Since middle life has suffered much from rheumatism, and has rapidly accumulated fat, but gives no history of any other diathesis. Has also suffered from naso-pharyngeal catarrh. Is right-handed. In 1876 had a slight attack, attended with vertigo, partial insensibility, and numbness, but without any distinct paralysis. A year later was again attacked, this time with well-marked hemiplegia. Although complete insensibility was at no time present during the attack, there was intense pain in the back of the head and in the nose on the left side, numbness and impairment of motion of the left arm, side, and leg, almost total inability to swallow, and, finally, a remarkable change in the quality of the voice, which, from having been full, deep, and sonorous, was reduced to a cracked, piping, and uncertain tone, which rendered its use almost impossible. Articulation was also impaired, the patient for months afterward being obliged to pronounce each syllable separately, speaking slowly and with difficulty. There was at no time or to any degree aphasia.

There was distinct ptosis, with paralysis of the left side of the face and tongue. After continuing two or three days the general symptoms began to subside, beginning with the leg, then the arm, and last of all the face, and slow but steady improvement continued for many months in all the above-mentioned conditions ex-

cept the voice. In this there was little apparent change for some time, but by degrees it became more readily controlled and less discordant, although the high-pitched quality has continued up to the present time, together with the loss of power and inability to force it. In 1882 a laryngoscopic examination showed the existence of complete abductor paralysis of the left vocal band, the position of which was in the median line. The larynx was remarkably easy of demonstration, and the diagnosis was afterward confirmed by Dr. Clinton Wagner. Laryngoscopic examinations made at intervals since 1882, the last one on February 12, 1885, in consultation with Dr. George M. Lefferts, have demonstrated no change in the position of the cord. There was, however, a slight attempt at rotation on the part of the left arytenoid, due evidently to the action of the inter-arytenoideus muscle. Efforts made to determine the electrical "reaction of degeneration" have not, thus far, proved successful. To summarize, in a case of common left hemiplegia, in which pharyngeal and laryngeal paralysis were especially well marked, all of the symptoms have disappeared in regular order except those relating to one set of muscles, namely, the laryngeal abductors of the left side; and these have continued paralyzed for a period of seven years.¹

CASE II.—Seguin² reports a case in which, with common hemiplegia of the left side without loss of consciousness, speech was much impaired by defect in articulation. The paralysis passed away rapidly, but the power of articulation was never wholly regained, the patient never afterwards being able to control the pitch of the voice, apparently from a lack of proper action of the muscles of the pharynx or larynx. No laryngoscopic examination was made. Later, the patient died from another hemiplegia, this time of the right side and complete, with absolute aphasia.

Autopsy.—Membranes and sinuses of brain normal. Surface of third frontal convolution of the right side yellow in color, with a tough elastic feel. This lesion, extending through the gray matter, was about an inch square and a quarter of an inch thick. The same change, but to a less extent, was found in the same location on the left side. The left middle cerebral artery was plugged by an embolus at a point one-half an inch from its origin.

¹ Case I. has already been reported in the New York Medical Journal.

² Transactions of the Neurological Association, 1877, p. 102.

A spot of brain about one-half an inch in diameter, supplied by this artery, was in a softened state.

"An interesting feature of the case," says Dr. Seguin, "is in connection with the very localized lesion in the right hemisphere and the first attack of hemiplegia, characterized by slight and transitory paralysis of the limbs, and by very great defect in articulation. Indeed, the patient never recovered the full use of her vocal organs. From this we may infer that the function of the third frontal convolution, on the right side in right-handed human beings, is intimately connected with the muscles governing the movements of articulation and phonation."

The diagnosis made in Case I. was, endarteritis of the third branch of the middle cerebral artery. From the reference before made to the anatomy of the brain it is evident that the motor-centres supplied by this artery were affected, namely, the centres for the leg, the arm, and the face. That the larynx was also paralyzed indicates that the motor-centre for the larynx was in the course of the occluded vessel. The blood-supply of the region, gradually restored by anastomosing branches, first returned at the terminal extremities of the anterior branch. Hence the leg was first to regain its normal function, afterward the arm, and later still the face. That the laryngeal centre was permanently paralyzed may be explained on the supposition that the arterial branch supplying it was an "end-artery," given off remotely from the distal or terminal extremity of the main trunk, so that anastomosis was not present, and its circulation could not be re-established. That the same accident may have happened in Case II. is conjectured by the position of the lesion found *post-mortem* upon the right side of the brain, as well as by the marked similarity of the resulting symptoms. In reviewing the above several points are worthy of especial mention :

a. The lesion was in both cases upon the right side of the brain. Irritation of the corresponding part upon the left side, in right-handed persons, produces aphasia.

b. In both cases the same muscular groups were affected, and in apparently the same manner.

c. In both the general symptoms in the same manner disappeared.

d. In both paralysis of the larynx was permanent.

Of course, while it must be admitted that upon a basis so slender as that afforded by these two cases, unique in the history of the subject, it is impossible to build any certain and unimpeachable deductions; still, in the light

of our present knowledge, and from the study of the considerations herein adduced, anatomical, physiological, and pathological, the following conclusions seem to be fairly justifiable :

1. That there is a cortical centre of motion for the human larynx.
2. That this centre is in the course of the third branch of the middle cerebral artery.
3. That it is toward the proximal end of this vessel.
4. That it is in the vicinity of the convolution of Broca.

1 EAST THIRTY-THIRD STREET.

The writer desires to express his indebtedness to DR. M. ALLEN STARR, of this city, for valuable assistance in the preparation of the above paper.

